Amendments to the Claims

This listing of claims will replace all prior versions, and listings, of claims in the application.

1. (Currently Amended) A method ~~for a systematic approach to forming experimental design for large complex systems, the method~~ of designing experiments for acquiring processing experience in the design and manufacture of a product comprising:

(a) ~~generating and developing an idea for a product~~ determining critical variables for the product;

(b) ~~develop an experimental design for the product, wherein the experimental design includes~~ generating causal map-based coefficients of the matrix A as a function of the critical variable;

~~(c) determining critical variables for the product;~~

~~(d)~~ (c) setting a design matrix U_k=0 and k=0;

~~(e)~~ (d) generating a base design matrix X;

~~(f)~~ (e) ~~running~~ evaluating $Y(P)=(I-B(B^TB)^{-1}B^T)[(XP)//U]A$ ~~&~~ according to Wynn's criterion, where P is a permutation matrix, I is an identity matrix, B is a blocking matrix, B^T is a transposed matrix of B, and A is a matrix composed of causal map-based coefficients; ~~and~~

~~(g) creating a design matrix U_k~~

(f) setting k←k+1;

(g) running an algorithm to choose the best of random column permutations matrices P;

(h) running an algorithm to choose the best column permutation matrix P that is near a previous solution; and

(i) setting design matrix $U_k \leftarrow [XP^k$ with rows from U_{k-1} appended]; and

(m) manufacturing prototype wafers using the experimental design matrix U_k.

2. (Canceled).

3. (Currently Amended) The method of Claim ~~2~~ 1, ~~wherein step (b)~~ further ~~includes~~ comprising:

~~(l)~~ (j) determining whether the design matrix U_k is at desired size; and

~~(m)~~ (k) if the design matrix U_k is not at the desired size repeating steps ~~(h)~~ (f) through ~~(m)~~ (k) until step ~~(l)~~ (j) indicates that the design matrix U_k is at the desired size.

4. (Currently Amended) The method of Claim ~~2~~ 3 ~~wherein step (b)~~ further ~~includes~~ comprising ~~(n)~~ (l) setting the experimental design using the design matrix U_k if step ~~(l)~~ (j) indicates that the design matrix U_k is at the desired size.

5. (Currently Amended) The method of Claim 4 further ~~including~~ comprising:

~~(o) manufacturing prototype wafers using the experimental design U_k;~~

~~(p)~~ (n) determining model responses from the prototype wafers;

(q) (o) determining whether the model responses are adequate; and

(r) (p) if the model responses are not adequate repeating steps (f) (e) through (r) (p) until step (q) (o) indicates that the model responses are adequate.

6. (Currently Amended) The method of Claim 5 further comprising:

(s) (q) assess and propose manufacturing tolerances for the design matrix U_k;

(t) (r) determine if the proposed manufacturing tolerances are manufacturable; and

(u) (s) if the manufacturing tolerances are not manufacturable repeating steps (b) (a) through (t) (r) until it is determined that the manufacturing tolerances are manufacturable.

7. (Currently Amended) The method of Claim 6 further comprising (v) (t) sending the design matrix U_k to production if it is determined that the manufacturing tolerances are manufacturable.

8. (Currently Amended) The method of Claim 7 wherein step (e) (d) includes:

(w) (d1) creating a causal network diagram using information determined in ste (e) step (a);

(x) (d2) creating an internode link-count distance matric using informaiton from step (w) (d1);

(y) (d3) creating a causal map using information from step (x) (d2);

(z) (d4) identifying response nodes from the causal map created in step (y) (d3); and

~~(aa)~~ (d5) calculating map-based coefficients from the information in the causal map.

9. (New) A method of developing a semiconductor device comprising:

a development phase including;

evaluating a plurality of processing alternatives;

tuning a nominal process target for each of said plurality of processing alternatives;

a pre-production phase including;

acquiring process experience based upon said tuned nominal process targets

comprising;

designing a plurality of experiments including;

determining a plurality of variables for a design of said semiconductor device

and the manufacturing of said semiconductor device;

creating a causal network diagram for said determined plurality of critical

factors;

transforming said causal network diagram into a causal map;

identifying response from said causal map;

calculating map-based coefficients of the matrix A as a function of said causal

map;

initializing an experimental design matrix U_k wherein k=0;

selecting a base design matrix X;

evaluating $Y(p) = (I-B(B^TB)^{-1})B^T)[XP//U]A$ according to Wynn's criterion,

wherein P is a permutation matrix, I is an identity matrix, B is a blocking

matrix, and B^T is a transposed matrix of B;

running an algorithm to choose the best of random column permutations

matrices P;

running an algorithm to choose the best column permutation matrix P that is

near a previous solution; and

setting $U_k \leftarrow$ [XP^k with rows from U_{k-1} appended]; and

modeling responses of said plurality of experiments;

determining a tolerance window for each tuned nominal process targets; and

a production phase including;

manufacturing a semiconductor device according to said process targets and said

tolerance windows.

10. (New) The method according to Claim 9, wherein a critical variable comprises a

response and a factor.

11. (New) The method according to Claim 9, wherein said creating said causal network

diagram comprises:

rendering causal relationships wherein a response is the root node, major factors are

spines branching of the response, factor groups as the primary branches, lower level factors

branching off each spine or off other low level factors, the number of responses can be more than one, responses can point causally to other responses and each factor is represented as a single node; and

identifying critical variables that affect other factors.

12. (New) The method according to Claim 9, wherein transforming said causal network diagram into said causal map comprises:

creating an internode link-count distance matrix, wherein a distance between any pair of nodes of a causal network is a minimum number of links of a path connecting the pair of nodes, the corresponding matrix giving said distances between any pair of nodes is a natural input data structure for multidimensional scaling; and

applying a multidimensional scaling algorithm.

13. (New) The method according to Claim 12, wherein said causal map includes information comprising:

a factor closer to a response node plausibly has a stronger effect;

two factors close together likely share an interaction;

responses sharing many factors cluster; and

higher-level factors tend toward a center of said causal map.

14. (New) The method according to Claim 9, wherein said modeling response of said

plurality of experiments comprises:

manufacturing prototype wafers for said plurality of experiments according to said

experimental design matrix U_k;

generating response models by empirically measuring and mathematically modeling said

prototype wafers; and

determine if said response models are adequate.

15. (New) The method according to Claim 9, wherein determining a tolerance window

comprises:

proposing tolerances for each tuned nominal process target;

assessing each proposed tolerance; and

determining if the proposed tolerances can be manufactured.